Low-Cost Booster Propulsion System Test Article

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The propulsion test article (PTA) provides a flexible test-bed environment to evaluate low-cost hardware RP–1/lox options for use on a future small payload expendable boosters. The test-bed will be in a stacked configuration as shown in figure 5 and will be tested in the B–2 test stand at Stennis Space Center (SSC). The major components of the PTA include the support structure, the lox and RP–1 tanks, the RP–1 and lox feedlines, the pressurization system including a heat exchanger, flight type avionics and test instrumentation and the 60-klbf thrust MSFC Fastrac engine. The Fastrac engine is scheduled for use on the X–34 program, therefore establishing this test-bed as the engine development and verification facility for the X–34 engine.

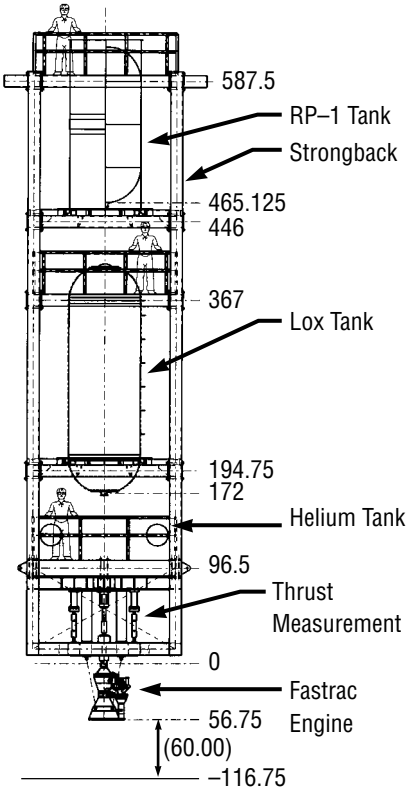

Figure 5.—The propulsion test article.

The PTA design began in May of 1996 and had as one of its fundamental requirements the necessity to fire the engine and propulsion system by January of 1998. The major milestones of the project are the systems requirements review held June 27, 1996, the preliminary design review held August 20, 1996, the critical design review scheduled for December 16, 1996, cold flow checkouts in November of 1997 and the first hot fire in January of 1998.

The PTA will provide a system test-bed to evaluate low-cost propulsion system components developed by NASA, traditional and nontraditional industries, as well as universities. The traditional industries refer to the classic space contractors possessing years of experience with flight hardware. The nontraditional industries are those business concerns which produce components and materials which are applied to commercial areas (i.e., gas bottles for hospital use, gasoline storage tanks for service stations). The heart of the low-cost booster technologies program lies in this canvassing of all of these groups to develop and test, both at a component and at a system level components and materials which could eventually be applied to use on commercial launch vehicle, developed by industry, which would have an extremely low-cost payload capability ($/lb).

The PTA design is being led by members of MSFC and the SSC. The design approach has entailed the use of the product development team (PDT). The project design is centered around four PDT's. They are the engine PDT, the Systems Integration PDT, the Avionics PDT and the PTA PDT, which has responsibility for the coordination and integration of the hardware into the PTA and the test stand. The test operations

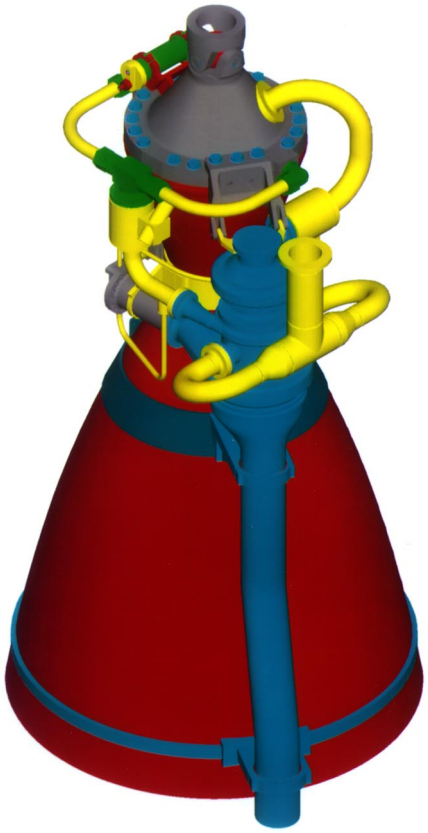

Figure 6.—The Fastrac engine.

personnel for the SSC serve as part of the test team. This close working relationship ensures the concurrent engineering required to complete this task in the aggressive schedule which has been undertaken. When the design is complete and the hardware is procured, it will be sent to SSC integrated and tested in the B–2 test stand.

The PTA will provide development data on a wide range of propulsion hardware which will allow the future development of an extremely low-cost launch vehicle. This capability will most likely be utilized in the launch of small payloads to a wide range of potential orbital inclinations. These small payloads could include scientific and engineering payloads in the areas of medicine, materials and space manufacturing. The design is based around a 72-in-diameter tank set and would be

representative of a booster with a 220-lb capability to low-Earth orbit.

The PTA will provide a flexible test-bed with the ability to test various propulsion components in a system environment, allowing NASA and industry to evaluate these components, with the perspective of their use in a low-cost booster, providing less expensive access to space.

Sponsor: Advanced Space Transportation Program Office

Biographical Sketch: Mark Fisher is member of the Propulsion Systems Branch in MSFC's Propulsion Laboratory. He has been an employee of NASA since 1990. Fisher leads the PTA product development team, an interlaboratory, intercenter team charged with the design, development and test of the PTA system. He received a B.A. degree in mathematics from Edinboro University of Pennsylvania, and a B.S. and an M.S. degree in mechanical engineering from Pennsylvania State University.